



Benato, L., Rooney, N. J., & Murrell, J. C. (2019). Pain and analgesia in pet rabbits within the veterinary environment: a review. *Veterinary Anaesthesia and Analgesia*, 46(2), 151-162.
<https://doi.org/10.1016/j.vaa.2018.10.007>

Peer reviewed version

License (if available):
CC BY-NC-ND

Link to published version (if available):
[10.1016/j.vaa.2018.10.007](https://doi.org/10.1016/j.vaa.2018.10.007)

[Link to publication record on the Bristol Research Portal](#)
PDF-document

University of Bristol – Bristol Research Portal

General rights

This document is made available in accordance with publisher policies. Please cite only the published version using the reference above. Full terms of use are available:
<http://www.bristol.ac.uk/red/research-policy/pure/user-guides/brp-terms/>

- Table 1: Details of physiological and behavioural changes reported in scientific studies on rabbit pain and analgesia** (NZW=New Zealand White, IV= Intravenous, IM=Intramuscular, SC=Subcutaneous, PO=Orally, d=Day, q12h=Every 12 hours, q24h=Every 24 hours, SRB= Compounded sustained-release formulation of buprenorphine, FCM= Faecal corticosterone metabolites)

Study	Rabbit number/Breed	Procedure	Analgesia	Physiological parameters	Outcome	Behavioural parameters	Outcome	Comments
Cooper et al. 2009	29/Dutch Belted	Ovariohysterectomy	3 groups: <ul style="list-style-type: none"> Buprenorphine 0.03 mg/kg IM q 12h for 2 d Meloxicam 0.2 mg/kg SC q 24h for 2 d 0.5% bupivacaine infused locally at the incision 	<ul style="list-style-type: none"> Haematology Biochemistry Body temperature Body weight Faecal output Faecal flora 	<ul style="list-style-type: none"> No changes in body temperature, haematology, biochemistry and faecal flora during the study Decrease in body weight and faecal output 	<ul style="list-style-type: none"> Food intake 	<ul style="list-style-type: none"> Decrease in food intake 	The changes in body weight, faecal output and food intake were found to be more severe when bupivacaine was used.
Leach et al. 2009	28/NZW	Ovariohysterectomy	4 groups: <ul style="list-style-type: none"> Meloxicam 0.2 mg/kg PO (Loding dose) Meloxicam 0.6 mg/kg PO (Loding dose) Meloxicam 1mg/kg PO (Loding dose) Control group 	<ul style="list-style-type: none"> Body weight 	<ul style="list-style-type: none"> Decrease in body weight in all animals 	<ul style="list-style-type: none"> Inactive pain behaviour (Twitch, wince, stagger, flinch, press, pain, adjust low, shuffle) Other behaviours (e.g. grooming, ear position, cage position, head shaking, etc) 	<ul style="list-style-type: none"> Increased inactive pain behaviour Minimal differences of the Other behaviours 	Inactive pain behaviour was considered the most indicative of all the behaviours assessed during the study
Weaver et al. 2010	20/NZW	Ovariohysterectomy and telemeter implantation	4 groups: <ul style="list-style-type: none"> Buprenorphine 0.02 mg/kg 	<ul style="list-style-type: none"> Body weight Faecal output 	<ul style="list-style-type: none"> Body weight decreased significantly in all animals 	<ul style="list-style-type: none"> Food and water intake 	<ul style="list-style-type: none"> Food and water intake decreased significantly in 	No statistical difference amongst the three

			<ul style="list-style-type: none"> SC q12h for 3 d Fentanyl 25-µg patch placed 24h prior surgery Ketoprofen 1mg/kg SC q 24h for 3 d Control group 			<ul style="list-style-type: none"> postoperative up to 7 days. Faecal output decreased significantly in all animals postoperatively 	<ul style="list-style-type: none"> Travel distance Rearing activity 	<ul style="list-style-type: none"> all animals postoperatively Travel distance and rearing activity decreased significantly in all animals postoperatively 	<ul style="list-style-type: none"> analgesic groups and the control group were found during the study
Farnworth et al. 2011	7/NZW	Abdominal implantation of a telemetric device	<p>All animals:</p> <ul style="list-style-type: none"> Carprofen 2 mg/kg SC once 	-	-	<ul style="list-style-type: none"> Several behaviours were recorded post operatively (e.g. grooming, exploring, lying, etc) 	<ul style="list-style-type: none"> Decreased behaviours: <ul style="list-style-type: none"> Grooming Food and water intake Exploring Stretching Others New behaviours: <ul style="list-style-type: none"> Full-body flex Hind leg shuffle Tight huddle Increased behaviours: <ul style="list-style-type: none"> Lying Drawing back Staggering Closed eyes 	<ul style="list-style-type: none"> The authors stated that behavioural indicators of pain may differ depending on housing and surgical procedure 	
Keating et al. 2012	8/NZW	Ear tattooing	<p>4 groups:</p> <ul style="list-style-type: none"> Sham tattooing with EMLA cream® Sham tattooing without EMLA cream® Tattooing with EMLA cream® Tattooing without EMLA cream® 	<ul style="list-style-type: none"> Heart rate Arterial blood pressure Serum corticosterone concentration 	<p>All the animals tattooed without EMLA cream:</p> <ul style="list-style-type: none"> Increased heart rate Increased arterial blood pressure <p>All animals with or without the EMLA cream®:</p> <ul style="list-style-type: none"> Increased Serum corticosterone concentration 	<ul style="list-style-type: none"> Facial expression Grooming Movement Rearing Vocalisation and struggling 	<ul style="list-style-type: none"> Increased grooming was noticed only in the animals tattooed without EMLA cream® Movement and rearing decreased in all animals Rearing, vocalisation and struggling was noticed in 	<ul style="list-style-type: none"> The Rabbit Grimace Scale developed during this study provides a validated pain assessment tool in rabbits. 	

								animals tattooed without EMLA cream ®	
Goldschlager et al. 2013	39/NZW	Vascular cut-down of the femoral artery		4 groups: <ul style="list-style-type: none"> Buprenorphine 0.03 mg/kg SC q12h for 3 d Meloxicam 0.2 mg/kg SC q24h for 3 d Buprenorphine 0.01 mg/kg and meloxicam 0.1 mg/kg SC q 24h for 3 d Single dose of 0.5 ml of 0.5% bupivacaine infused locally 	<ul style="list-style-type: none"> Faecal corticosterone metabolites (FCM) Faecal output Urine output Body weight Haematology Biochemistry Faecal flora 	In the buprenorphine-meloxicam group, FCM did not change while it increased in the other 3 groups In all animals: <ul style="list-style-type: none"> Decreased faecal output Normal urine output Decreased body weight Normal range of haematology and biochemistry Normal faecal flora 	<ul style="list-style-type: none"> Food intake 	All animals showed a decrease in food intake	The study suggests that a multimodal approach using a combination of buprenorphine and meloxicam may control pain better than meloxicam or buprenorphine given alone.
Hedenqvist et al. 2016	18/NZW	Bilateral axillary sinus augmentation		2 groups: <ul style="list-style-type: none"> Buprenorphine 0.03mg/kg IV and 0.02 mg/kg SC (Loading dose) and carprofen 5 mg/kg SC q 24 h for 4 d Buprenorphine 0.03mg/kg IV and 0.02 mg/kg SC (Loading dose) and saline (NaCl) 	<ul style="list-style-type: none"> Body weight 	<ul style="list-style-type: none"> No difference between the two groups 	<ul style="list-style-type: none"> Facial expressions 	<ul style="list-style-type: none"> No differences between the two groups were found 	Facial expressions such as orbital tightening and ear positions were considered easy to evaluate by inexperienced people during the study
DiVincenti et al. 2016	24/NZW	Tibial titanium implants		2 groups: <ul style="list-style-type: none"> Buprenorphine 0.02 mg/kg SC q12 h for 3 d 	-	-	<ul style="list-style-type: none"> Grimace scale score Activity score 	In both groups: <ul style="list-style-type: none"> Increased in Grimace score Decreased in activity score 	The two treatment groups were comparable during the

-
- Compounded
sustained-
release
formulation of
buprenorphin
e (SRB) 0.12
mg/kg once
-

study with no
major
adverse
effects
reported